IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
Before the Board of Patent Appeals and Interferences

2674 AF
13/ Appeal Brief
5-5-04
No

In re Patent Application of

COKER et al

Serial No. 09/868,241

Filed: August 28, 2001

Title: MODIFIED WEIGHTED BIT PLANES FOR DISPLAYING GREY LEVELS ON OPTICAL ARRAYS

Atty Dkt. 124-861
C# M#

TC/A.U.: 2674

Examiner: D. Dinh

Date: April 28, 2004

Reg for Sgt (1)

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

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1100 North Glebe Road, 8th Floor
Arlington, Virginia 22201-4714
Telephone: (703) 816-4000
Facsimile: (703) 816-4100
SCS:kmm

NIXON & VANDERHYE P.C.
By Atty: Stanley C. Spooner Reg. No. 27,393

Signature:

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of

COKER et al — Atty. Ref.: 124-861

Serial No. 09/868,241 — Group: 2674

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For: MODIFIED WEIGHTED BIT PLANES FOR DISPLAYING GREY LEVELS ON OPTICAL ARRAYS

* *

APPEAL BRIEF

On Appeal From Group Art Unit 2674

Stanley C. Spooner
NIXON & VANDERHYE P.C.
8th Floor, 1100 North Glebe Road
Arlington, Virginia 22201-4714
(703) 816-4028
Attorney for Appellant

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APPEAL BRIEF

Sir:

I. REAL PARTY IN INTEREST

The real party in interest in the above-identified appeal is QinetiQ Limited by virtue of an Assignment from The Secretary of State for Defence recorded February 20, 2002 (Reel 12831, Frame 0459) and an Assignment from the inventors to The Secretary of State for Defence recorded August 28, 2001 (Reel 12196, Frame 666).

II. RELATED APPEALS AND INTERFERENCES

There are believed to be no related appeals or interferences with respect to the present application and appeal.

III. STATUS OF CLAIMS

Claims 1-3, 6 and 12-15 stand rejected, with claim 5 objected to in the outstanding Final Rejection. The Examiner contends that unspecified claims are indefinite under 35 USC §112 and that claims 1-3, 6 and 12-15 are obvious under 35 USC §103 in view of the prior art. Claim 5 is objected to as being dependent from a rejected claim, but would otherwise be allowable.

IV. STATUS OF AMENDMENTS

A clarifying Amendment Under Rule 116 responsive to issues raised by the Examiner for the first time in the Final Rejection was submitted on March 1, 2004. Entry of the Amendment was denied in the Advisory Action mailed March 5, 2004 (Paper No. 12) on the basis that the claims raised new issues requiring further consideration and/or search.

V. SUMMARY OF THE INVENTION

The present invention relates to liquid crystal displays, and in particular, to methods of driving such displays in a binary manner so as to avoid any imbalance in direct current applied to the overall cell.

Methods of driving such LCD cells or digital modulators utilize a "gray scale" to generate shades of light between pure white and pure black. By combining light from the display through various color filters, varying levels of red, green and blue can be provided which, when combined by the viewing eye, provide differing colors of differing intensity.

An array of digitized values of amplitudes corresponding to the desired gray scale values allocated to each pixel of an array of pixels in a liquid crystal display is decomposed into a multiplicity of bit planes. This multiple bit plane technique is conventionally used to provide an n-level gray scale image, normally from a plurality of binary image planes of equal time duration. However, in a preferred form, the durations of the bit planes are weighted in terms of one level (exponent) of the digitization. Thus, the duration of the least significant bit will be shorter than the duration of the most significant bit. By varying the duration, the digital signal applied will be a series of ones and zeroes, and it is only necessary to display each bit plane for a total period proportional to its binary weighting in order to provide a time averaged image equivalent to the digitized gray scale

image. In other words, if a 4-digit binary number is used and the lower the actual number the darker the pixel, then a 0001 digital number (with the least significant bit on the right) means that light would pass through that particular pixel for only the shortest period of time (equal to the duration of the least significant digit in the weighted bit plane scheme). On the other hand, if a very bright pixel is needed, then the n-digit number might be 1000 in which case the pixel would be transparent for the longest single period of time for the weighted bit plane durations. By adjusting the duration in proportion to the significance of the digits in the n-digit number, an appropriate gray scale modulation can be provided in response to a digital driving signal.

Unfortunately, utilizing a digitally driven liquid crystal display presents a problem of maintaining the direct current balance at individual pixels. Because the electrostatic voltage at any given pixel determines whether that pixel passes or blocks light traveling through the liquid crystal display, continually applying positive pulses will result in a build-up of dc voltage at that pixel, which may then make the pixel less sensitive to subsequent driving pulses.

Thus, it is desirable to maintain the dc balance at a fixed level, which is the desired average dc voltage. Generally, this is zero, but it could be any desired average dc voltage. It can be seen that if a pixel is driven by 0001, there are three "0" pulses compared to one "1" pulse. This would result in a shift of the dc balance for that pixel towards a "0" dc charge, rather than having a neutral dc

balance. Similarly, the number 1110 would shift the DC balance away from equality towards the voltage of a "1" pulse. Obviously, numbers 0011 or 1100, because they have equality in ones and zeroes, would maintain the dc balance.

In response to the problem of maintaining dc balance while providing digital weighted bit plane modulation, appellants discovered that choosing a closely adjacent digital value which has a similar intensity but a significantly different average dc voltage can improve dc balance, bringing it closer to the desired equality.

In the example shown in appellants' specification at page 9, lines 16-19, it is desired to apply the gray scale 27 over a plurality of frames to a particular pixel. However, the digital number 27 is represented by "110110" (in the notation in which the least significant bit is on the left) which has four "1s" and only two "0s," resulting in a dc imbalance of two (towards the "1s" charge).. However, over a 2-frame exposure, the average gray scale of 27 could be replaced by 28 for one frame and 26 for a second frame. As long as the frame rate is high enough to avoid perceptible flicker, the viewing eye will know no difference and the color will be accurate.

However, because the number 28 is represented by "001110" and the number 26 by "010110," in each instance the dc applied to the pixel is balanced and thus it is balanced over the two frames. Appellants' specification, on page 9, lines 20-23, also provides a different example in which the gray scale level 15 is

used twice in addition to the gray scale level 14 and a gray scale level 16 used once each. Over the four frames, the average gray scale level is 15 and there are equal numbers of 1s and 0s so as to provide the desired dc balance.

Thus, appellants' invention provides a light modulating apparatus which comprises "**an array of light modulating pixels**" and a "**drive means adapted to drive the array**" such that it alters "the n-digit number in respect of at least one said pixel to **a closely adjacent value** so that the numbers of 1s and 0s written thereat oversaid writing of a complete image are brought closer to equality thereby improving the dc balance." (emphasis added).

This technique can be used by itself or in combination with other techniques for improving the dc balance. As will be clearly obvious to those of ordinary skill in the art, as the numbers of 1s and 0s written at a pixel are "brought closer to equality," the dc balance will improve. Equality means an equal number of 1s and 0s and, therefore, if the difference in the numbers of 1s and 0s are brought closer to equality, i.e., the same number of 1s as 0s at a pixel, there will be an improvement in the dc balance.

VI. ISSUES

Whether unspecified claims are unpatentable under 35 USC §112 as being indefinite.

Whether claims 1-3, 6 and 12-15 are obvious under 35 USC §103 over Aoki et al (U.S. Patent 4,775,891).

VII. GROUPING OF CLAIMS

The rejected claims stand or fall together based upon the patentability of the individual independent claims 1, 2, 12, 13 and 14.

VIII. ARGUMENT

1. Discussion of the References

Aoki et al (U.S. Patent 4,775,891) teaches a liquid crystal display which was able to utilize NTSC video signals without a degradation in image quality. The Aoki reference teaches using only half the video signal and includes an A/D converter 3 which sampled the video signal and produced a 4-bit digital output (see column 5, lines 13-15). In comparison with appellants' claims, the Examiner may consider the output of the A/D converter 3 as an image signal in accordance with the present invention.

Further, Aoki shows a device wherein the driving means (data control circuit 4) alters the n-bit number to a closely adjacent value having its number of 1s and 0s closer to equality. In the Final Rejection, the Examiner states as an example Figure 4, although appellants have previously pointed out that it appears that Figure 3 was intended. In any event, at Figure 3 in Aoki, at row 9, the 4-bit

number 0111 is replaced with two 3-bit numbers 011 and 100. While it appears that the goal of the Aoki teaching is to arrive at some improved dc balance, Aoki's method appears to be completely different from that of the present invention.

Firstly, Aoki does not teach a driving means which alters "the n-digit number" in respect of at least one pixel to "**a** closely adjacent value" (emphasis added). Aoki clearly teaches directly the opposite, in that the single n-digit number is replaced by **two** (n-1) digit numbers, i.e., as disclosed in Aoki the 4-digit number is replaced by two 3-digit numbers. Thus, Aoki obtains its digital balance by changing the n-digit number into a plurality of n-1 digit numbers.

There is no teaching in Aoki of changing an n-digit number into a single "closely adjacent value" so that during the subsequent numbers in the weighted bit plane technique, the total numbers of 1s and 0s written thereat are brought closer to equality, thereby improving the dc balance at that pixel.

2. Discussion of the Rejections

In section 1 of the Final Rejection, the Examiner indicates that there are "claim rejections – 35 USC §112" and yet no specific claims stand formally rejected under §112. This point was raised in appellants' Amendment Under Rule 116 in the first paragraph on page 7, and appellants speculated that the Examiner intended to reject claims 1-3, 5, 6 and 12-15. However, the Examiner has not clarified the basis for his rejection or confirmed that he intended to reject

claims 1-3, 5, 6 and 12-15 under 35 USC §112. Again, clarification is requested, although appellants will assume for the purpose of this Appeal that the Examiner intends to reject claims 1-3, 5, 6 and 12-15 under 35 USC §112.

Claims 1-3, 6 and 12-15 stand rejected as unpatentable over the Aoki reference. To the extent the Examiner's rejection is understood, it appears that the Examiner believes that because Aoki teaches **a** method step of reducing inequalities, this renders **all** methods, whether or not different, obvious in view thereof. Specifically, the Examiner suggests that Aoki's change from **a** 4-digit number to **two** 3-digit numbers meets the claim limitations. While appellants' previously submitted Rule 116 Amendment attempted to further clarify that this cannot be the case, the existing claim language clearly supports the view that Aoki and the claimed invention comprise two different methods.

3. The Errors in the Final Rejection

There are at least three significant errors in the Final Rejection and they are summarized as follows:

(a) The Examiner misapplies 35 USC §112 in a manner contrary to the Manual of Patent Examining Procedure (MPEP);

(b) Aoki does not teach altering the n-digit number to "a closely adjacent value;" and

(c) Aoki teaches away from the invention of claims 1, 2 and 12-14.

(a) The Examiner misapplies 35 USC §112 in a manner contrary to the Manual of Patent Examining Procedure (MPEP)

As noted above, it is unclear whether there is a pending rejection of the claims under 35 USC §112. However, the discussion of alleged indefiniteness in paragraph 1 of the Final Rejection seems to indicate that the Examiner at least intended to reject claims 1-3, 5, 6 and 12-15 under 35 USC §112, and therefore a discussion of this assumed rejection will be set forth.

The Examiner suggests that the language in appellants' claim "the numbers of 1s and 0s written thereat over said writing of a complete image are brought closer to equality thereby improving the dc balance" is a relative term which renders the claim indefinite. The Examiner takes the position that the specification does not provide "a standard for ascertaining the requisite degree" (presumably of "closeness?").

The Examiner is apparently suggesting by his example that the amount of improvement in dc balance is variable and therefore the claim is indefinite. There is no requirement in 35 USC §112 that the benefit achieved in a claimed invention be definite. However, what the claim actually says is that the driving means alters one number to be another number, so that the total numbers of 1s and 0s over the writing of a complete image are "closer to equality." Thus, it is the change from the dc imbalance of the original writing of the n-digit number to the subsequent writing of an n-digit number that there is a change in any inequality of the number

of 1s and 0s. The claim simply requires that the 1s and 0s of the subsequent "closely adjacent values" be "closer to equality" than the 1s and 0s written with respect to "the n-digit number."

Numerous examples of the above are shown in appellants' specification, particularly at page 9, lines 16-19. In this example, the number 27 (110110) has an imbalance of four 1s and only two 0s, and thus it has an imbalance of two. Closely adjacent numbers are 28 (001110) and 26 (010110). Thus, the present method changes the one n-digit number (in this example 5-digit number 110110) to a closely adjacent number, i.e., 001110. The closely adjacent number has an equal number of 0s and 1s. Another closely adjacent number is 26 (010110) which also has an equal number of 1s and 0s. Thus, changing the number 27 to closely adjacent number 28 during one frame and to closely adjacent number 26 in the next frame provides the average gray scale of 27 with perfect dc balance (clearly the balance equality of the changed numbers is an improvement over the balance of the original number 27).

In order to appreciate and benefit from appellants' invention, it is not necessary to obtain perfect dc balance in each application. However, appellants' claim does indicate that the balance must be **closer** to equality with the closely adjacent values written over the writing of the complete image. It is noted that the complete image may require a plurality of frames, as would be the case with the two frames in the example discussed on page 9, lines 16-19.

The claim requirement that the dc balance be brought "closer to equality" is relative terminology which is clearly addressed in the MPEP Section 2173.05(b). As stated in the Court of Appeals for the Federal Circuit and reprinted in the cited MPEP section, "the fact that claim language, including terms of degree, may not be precise, does not automatically render the claim indefinite under 35 USC §112, second paragraph."

Appellants' independent claim 1 does not care how close to equality the change renders the number – only that it be closer to equality than the original n-digit number. Also, it is noted that the n-digit number is changed to "**a** closely adjacent value" (emphasis added). This doesn't suggest a plurality of numbers, but rather that it is changed to a closely adjacent value for one portion of the writing "of a complete image" and may be changed to another closely adjacent value over another portion or the remainder of the complete image. It is only necessary that the numbers of 1s and 0s written over the writing of the complete image are closer to equality than they would be with the original n-digit number by itself.

Thus, anyone reading claim 1 would understand that as long as the numbers are even slightly closer to equality than the original numbers, they have met that limitation of claim 1. The MPEP Section 2173 and the Court of Appeals for the Federal Circuit clearly indicate that if one of ordinary skill in the art can determine whether the sum of the numbers is closer to equality, then that limitation is clearly

definite from the standpoint of 35 USC §112. By examining the initial imbalance number and then the subsequent imbalance number, one can easily determine whether the numbers of 1s and 0s have changed and are closer to being equal. If the numbers of 1s and 0s are very slightly closer to equality or are perfectly equal makes no difference; as long as they are closer to equality, they meet the claim terminology. Therefore, the claim is clearly definite under 35 USC §112, both as set forth in the MPEP and as set forth in the decisions of the Court of Appeals for the Federal Circuit.

The Examiner's misapplication of 35 USC §112 requiring appellants to specify some degree of equality is clearly inappropriate and is erroneous as a matter of law.

(b) Aoki does not teach altering the n-digit number to "a closely adjacent value"

As noted in the description of the Aoki reference, this prior art teaches changing the n-digit number to two separate numbers. The example set forth in the Final Rejection is alleged to be in Figure 4, but appellants believe the Examiner intended to refer to Figure 3, row 9, which teaches the original number is 0111 and that this is then changed into two separate numbers: 011 and 100.

While it is noted that in appellants' specification the least significant bit of each of the numbers is on the left (apparently this is a UK convention as opposed to the conventional writing of digital numbers in the US in which the least

significant bit is on the right), the Aoki 4-bit number 0111 is not converted to "a closely adjacent value" and rather is converted to two separate values, i.e., 011 and 100 (also note that the Examiner's Final Rejection has an error in his discussion as row 9 of Figure 3 shows the original number being 0111, the second number being 011 and the third number being 100, not "110" as set out in the Final Rejection).

However, the Examiner correctly notes that the inequality of the original number is 2 (three 1s and one 0) and that the inequality of the two subsequent numbers is 1 (two 1s – one 0). Thus, **if** appellants' claim only stated that the n-digit number was changed to closely adjacent values and assuming that 011 and 100 are closely adjacent values, then it could be argued that Aoki discloses a portion of the present invention. However, appellants' claim states that "the n-digit number" is altered to "**a** closely adjacent value," not a plurality of closely adjacent values. Therefore, Aoki, in not teaching alteration to a single closely adjacent value, but rather an alteration to at least II adjacent values, does no teach or render obvious appellants' claim.

Moreover, the Examiner has not shown or demonstrated how 011 is closely adjacent in value to 0111 or that 100 is closely adjacent in value to 0111.

The Examiner has simply ignored the claim limitation that "the n-digit number" is altered to be "a closely adjacent value." While appellants' Rule 116 Amendment would have clarified that the "n-digit number" is changed to a

different "n-digit number," this limitation is not needed in order to clearly define over the Aoki reference.

The burden is on the Examiner to establish how or where the Aoki reference teaches the claim limitation of altering "the n-digit number" to "a closely adjacent value." Aoki does not teach this and therefore cannot render obvious appellants' independent claims 1, 2, 12, 13 and 14 or any claims dependent thereon.

(c) Aoki teaches away from the invention of claims 1, 2 and 12-14

The above comments regarding the Aoki reference are herein incorporated by reference. Quite clearly, Aoki teaches that it is desirable when processing driver signals to divide an n-digit number into a plurality of other (n-1) digit numbers and perhaps thereby achieve some measure of dc balance. Assuming that Aoki teaches some improvement in dc balance, this is accomplished by dividing the n-digit number up into two n-1 digit numbers. This division would clearly lead one of ordinary skill in the art away from appellants' claimed apparatus and method. How or why the Examiner would ignore the teachings of the Aoki reference requiring a plurality of subsequent smaller numbers is not seen or understood.

Appellants have pointed out previously that the Court of Appeals for the Federal Circuit has consistently stated that it is "error to find obviousness where

references 'diverge from and teach away from the invention at hand'." *In re Fine*, 5 USPQ2d 1596, 1599 (Fed. Cir. 1988). This same Court in this same case held that "the PTO has the burden under §103 to establish a *prima facie* case of obviousness. *Id.* at 1598. The Court went on to say that the PTO "can satisfy this burden only by showing some objective teaching in the prior art . . . ." *Id.*

The Patent Office has pointed to no teaching in the Aoki reference which discloses or renders obvious the apparatus set forth in appellants' independent claims. The Examiner has emphasized in the Final Rejection that the Aoki reference does not teach altering the n-digit number to "a closely adjacent value" and instead clearly teaches that the number is altered to be two separate numbers. This clearly would lead one of ordinary skill in the art away from appellants' claimed combination.

IX. CONCLUSION

Assuming the Examiner intended to reject claims under 35 USC §112, he has misapplied the statute and such misapplication is contrary to the instructions contained in the MPEP Section 2173.05(b). With respect to the obviousness rejection, the cited Aoki reference does not teach altering the n-digit number to a single closely adjacent value. The Examiner has not shown how the values are "closely adjacent" and the Examiner concedes that Aoki alters the number to at least two separate numbers. The Aoki teaching would tend to lead one of ordinary

skill in the art away from appellants' claimed combination of elements, and the Examiner has not indicated how or why one of ordinary skill in the art would ignore the contrary teachings of the Aoki reference.

Thus, and in view of the above, the rejections of claims 1-3, 6 and 12-15 are clearly in error and reversal thereof by this Honorable Board is respectfully requested.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: _____

Stanley C. Spooner
Reg. No. 27,393

SCS:kmm
Enclosures
Appendix A - Claims on Appeal

APPENDIX A

Claims on Appeal

1. Light modulating apparatus comprising:

an array of light modulating pixels; and

drive means adapted to drive the array to write a complete image by a weighted bit plane technique in response to an image signal representing a set of n-digit binary numbers defining the intended intensities of respective pixels of the array, n being an integer greater than one, wherein the pixels are liquid crystal pixels, and the driving means is arranged to alter the n-digit number in respect of at least one said pixel to a closely adjacent value so that the numbers of 1s and 0s written thereat over said writing of a complete image are brought closer to equality thereby improving the dc balance.

2. Light modulating apparatus comprising:

an array of light modulating pixels; and

drive means adapted to drive the array to write a complete image by a weighted bit plane technique in response to an image signal representing a set of n-digit binary numbers defining the intended intensities of respective pixels of the array, n being an integer greater than one, wherein the pixels are liquid crystal pixels, and over a plurality of successive complete images the driving means is arranged to alter the n-digit number in respect of at least one said pixel in at least one said complete image to a closely

adjacent value so that the numbers of 1s and 0s written at said at least one said pixel over the plurality of images are brought closer to equality thereby improving the dc balance.

3. Display apparatus according to claim 2 wherein said driving means is arranged so that values of said number over said plurality of images provide an average intensity at said at least one pixel substantially equal to the intended intensity.

5. Display apparatus according to one of claims 1-3, wherein said driving means is arranged so that said numbers of 1s and 0s written at said at least one said pixel are brought to equality.

6. Display apparatus according to one of claims 1-3 wherein said driving means includes a look-up table for determining how said at least one number is to be altered.

12. A method of image signal processing for a weighted bit plane technique, in which an image signal represents a set of n-digit binary number signals each indicative of the intended intensity level of a respective one of a corresponding array of binary pixels, wherein at least one said binary number has an inequality of 1s and 0s, wherein said method comprises the step of altering said at least one binary number to a closely adjacent value to at least reduce said inequality therein and so that any inequality of 1s and 0s in each of the rest of said set of numbers is left unchanged, reduced or removed.

13. A method of writing and displaying an image in response to an image signal representing a set of n-digit binary numbers each indicative of the intended intensity level of a respective one of a corresponding array of binary pixels, a complete image being written using a weighted bit plane technique, the method comprising the step that at least one said binary number is altered to a closely adjacent value such that over the writing of said complete image an inequality of 1s and 0s at the corresponding pixel is at least reduced and so that any inequality of 1s and 0s at pixels for each of the rest of the said set of numbers is left unchanged, reduced or removed.

14. A method of writing and displaying an image in response to an image signal representing a set of n-digit binary numbers each indicative of the intended intensity level of a respective one of a corresponding array of binary pixels, using a weighted bit plane technique, wherein at least one binary number produces an inequality of 1s and 0s at its pixel over the writing of a complete image, wherein said method comprises the steps of:

writing a plurality of images each approximating said complete image in succession; and

altering said at least one binary number to a closely adjacent value in at least one of said plurality of images so that over said succession the said inequality of 1s and 0s is at least reduced and any inequality of 1s and 0s at each of the other pixels is left unchanged, reduced or removed.

15. A method according to claim 13 or claim 14 wherein at least one bit plane is refreshed during the writing of a said complete image.